Effects of HIV Counseling and Testing on Sexual Risk Behavior: A Meta-Analytic Review of Published Research, 1985–1997

ABSTRACT

Objectives. This study examined whether HIV counseling and testing leads to reductions in sexual risk behavior.

Methods. The meta-analysis included 27 published studies that provided sexual behavior outcome data, assessed behavior before and after counseling and testing, and provided details sufficient for the calculation of effect sizes. The studies involved 19 597 participants.

Results. After counseling and testing, HIV-positive participants and HIV-serodiscordant couples reduced unprotected intercourse and increased condom use more than HIV-negative and untested participants. HIV-negative participants did not modify their behavior more than untested participants. Participants' age, volition for testing, and injection drug use treatment status, as well as the sample seroprevalence and length of the follow-up, explained the variance in results.

Conclusions. HIV counseling and testing appears to provide an effective means of secondary prevention for HIV-positive individuals but, as conducted in the reviewed studies, is not an effective primary prevention strategy for uninfected participants. Theory-driven research with attention given to the context of testing is needed to further explicate the determinants of behavior change resulting from HIV counseling and testing, and the effectiveness of specific counseling approaches. (*Am J Public Health.* 1999; 89:1397–1405)

Lance S. Weinhardt, MS, Michael P. Carey, PhD, Blair T. Johnson, PhD, and Nicole L. Bickham, MS

Opportunistic infections resulting from AIDS remain a leading cause of premature death in the United States. More than 400 000 people have died of AIDS-related complications, and more than 250 000 adults and children are living with AIDS.[1] An additional 630 000 to 900 000 people are infected with HIV but have not yet developed the conditions required for a diagnosis of AIDS.[2] Worldwide, the problems of HIV infection and AIDS are even greater.[3,4] Anti-retroviral treatments for HIV disease can improve quality of life and delay AIDS-related deaths[5,6]; despite these advances, however, there is currently no cure or vaccine for HIV infection. Thus, the best way to prevent infection is to avoid behaviors that result in contact with the blood, semen, or vaginal fluids of an HIV-infected individual.[7,8]

HIV counseling and testing (HIV-CT) is the largest and most costly HIV prevention effort in the United States. Expanded use of HIV-CT as a prevention strategy has also been advocated in developing countries.[9] The primary objectives of the HIV-CT system are (1) to provide an opportunity for persons to learn their HIV serostatus and, if infected, to obtain referrals for medical and psychosocial care, and (2) to provide counseling so that clients might change their behavior to avoid infection or, if already infected, to avoid transmitting the virus to others.[10] To achieve the latter objective, the Centers for Disease Control and Prevention (CDC) recommends a client-centered counseling approach, including personalized risk assessment, development of a personalized risk reduction plan, and referrals appropriate to the client's test results.[10] In this article we focus on the effectiveness of HIV-CT in achieving this objective.

As of 1992, approximately 60 million Americans (one third of the adult population) had been tested for HIV antibodies[11,12]; 50% of the tests were performed at publicly funded sites.[13] From 1989 to 1995, more than 2 million people were tested annually at public sites, with 1 million people tested for the first time each year.[13,14] A cost-benefit analysis of the CDC's national HIV-CT program[15] revealed that over $100 million is allocated annually by the CDC to more than 5000 sites across the United States and its territories.[16] Clearly, HIV-CT provides an opportunity to perform individualized HIV risk behavior interventions with more people than any other single HIV prevention program. It is crucial that such a widespread and costly program fulfill its purpose and that its effectiveness be evaluated.

Previous reviews of the HIV-CT literature have concluded that couples who are serodiscordant for HIV, when tested and counseled together, reduce their risk behavior, but that the effects of HIV-CT on sexual risk behavior in other groups remain largely uncertain because of inconsistencies in study outcomes.[16–22] However, the most recent comprehensive review of studies examining the effects of HIV-CT on HIV risk behavior[19] was published more than 7 years ago, and new data are now available. Moreover, confidence in the conclusions of earlier reviews is limited because they were guided by qualitative interpretations rather than empirical synthesis.[23,24]

In this article we present a comprehensive meta-analytic review of the effects of HIV-CT on sexual behavior that places the participants at risk for HIV infection. We focused exclusively on sexual behavior because sexual behavior remains the primary vector for transmission of HIV[1] and because

The authors are with the Department of Psychology, Syracuse University, Syracuse, NY.

Requests for reprints should be sent to Michael P. Carey, PhD, Department of Psychology, Syracuse University, 430 Huntington Hall, Syracuse, NY 13244-2340 (e-mail: mpcarey@syr.edu).

This paper was accepted December 10, 1998.

we wanted a sample of study outcomes that were conceptually and methodologically similar. We excluded unpublished data (e.g., conference abstracts, doctoral dissertations) for 2 reasons. First, because the published reports included many nonsignificant findings, we reasoned that if a publication bias does exist in the HIV-CT literature, it is probably based more on methodological quality than on the pattern of results. Second, most data contained in conference abstracts were subsequently published in the peer-reviewed literature.

Previous narrative reviews and the risk reduction goals of HIV-CT led to the hypotheses that study participants who received an HIV-positive test result, individually or with a partner, would exhibit greater risk reduction than HIV-negative participants, who, in turn, would exhibit greater risk reduction than untested participants. We tested this hypothesis and, in addition, hypotheses about moderating variables that might explain variations in effect sizes across studies.

Methods

Sample of Studies

Studies were identified through 3 methods: (1) computer searches of MEDLINE and PsycLIT databases from January 1985 (the year that HIV antibody testing was approved for public use) through June 1997, using combinations of the key words *AIDS, HIV, test** (the asterisk indicates a wildcard operator; i.e., all terms starting with *test* were retrieved), *counseling, serodiagnosis, serostatus, sex**, and *behavior*; (2) manual searches of the journals *AIDS, AIDS Care, AIDS Education and Prevention, American Journal of Public Health, Health Psychology, Journal of the American Medical Association,* and *Sexually Transmitted Diseases* for the years 1985 through 1997; and (3) inspection of the reference lists of all identified articles. The latter method was repeated until all potentially relevant articles from these sources were identified.

Identified studies were included if they provided (1) assessment of when, relative to data collection, participants underwent HIV-CT; (2) sexual behavior outcome data or a proxy measure (e.g., sexually transmitted disease [STD] incidence); (3) 2 or more assessments with the same participants, to allow examination of behavior change over time; and (4) summary or inferential statistics sufficient for the calculation of within-group effect sizes. Thirty-four studies met criteria 1 through 3. With regard to criterion 4, two studies [25,26] were excluded because they provided neither the significance level for the relevant within-group comparison nor other data needed to make the comparisons. Finally, when more than 1 study presented data from the same participants, only the study with the most direct examination of the effects of HIV-CT was included; this criterion resulted in the exclusion of 6 studies.[27–32]

Study Characteristics Coded

Study characteristics were coded with 2 goals in mind: description and explanation. Characteristics that described the studies were year of publication, dates of data collection, and geographic location (city, state, and country). Characteristics that described the participants were educational attainment (in years); race/ethnicity (proportion White, African American, and Latino, or international sample); sexual orientation (proportion heterosexual, homosexual, bisexual); and identified risk group (men who have sex with men, injection drug users, socially or economically disadvantaged group, in HIV-endemic area or not).

Characteristics that provided information about the predictor variables were number of participants who were tested, number who received a positive test result for HIV, number who received a negative test result for HIV, and number who were untested. Characteristics of counseling that were coded were presence or absence of personalized risk assessment; inclusion of information about transmission routes; inclusion of information about preventive behavior; explanation of HIV antibody testing; education about proper condom use; peer group discussion; partner notification; and number of minutes of pretest and posttest counseling. Characteristics related to the sexual risk behavior outcome variables were level of measurement (categorical, ordinal, ratio); type of risk behavior (number of sexual partners, condom use, unprotected intercourse, proxy measure); and length of reporting period (in days). Finally, potential moderators of study effect sizes were coded: sex of participants (proportion female); average age of participants (in years); volition for HIV-CT (sought HIV-CT, accepted HIV-CT as part of a study, or mandated to receive HIV-CT); HIV seroprevalence in sample (number of infected participants divided by the total number of participants); attrition rate (proportion of participants who did not return for the follow-up assessment); and length of follow-up (in days).

All study characteristics were coded independently by 2 raters. Reliability of the coding was evaluated for each category by computing κ values for interrater agreement across all studies[33]; κ values ranged from 0.81 to 1.00 (median = 0.97). Lower interrater reliability resulted from categories containing values that had to be estimated for some studies (e.g., length of follow-up in days). Discrepancies in coding were resolved by discussion and further examination of the studies.

Computation and Analysis of Effect Sizes

The effect size used in this investigation was *d*, the standardized mean difference index,[34] which was computed from sexual risk behavior data from before and after HIV-CT. The effect size *d* can range from zero to plus or minus any number of standard deviations, depending on the direction and magnitude of the effect. Conventionally speaking, an effect size of ±0.20 is "small," a value of ±0.50 is "medium," and values exceeding ±0.80 are "large."[35] As in the case of most meta-analyses of intervention studies, effect sizes were expressed in such a way that positive effect sizes indicated reductions in sexual risk behavior.

Effect sizes were calculated on the basis of means and standard deviations, or if these were not available, on the basis of proportions or other data (e.g., n and F, *t*, or χ^2 values). If only n's and significance levels were presented, this information was used to estimate effect sizes. We used the pooled standard deviation in cases where only the mean and standard deviation were presented. Compared with the use of paired observations, use of the pooled standard deviation results in effect sizes that may be biased toward zero. When authors reported dichotomous outcomes, such as the proportion of participants who engaged in unprotected sex during specified periods before and after the counseling and testing, we treated the proportions as means and derived the pooled standard deviation by following commonly available equations.[34,36–39] A correction for bias due to sample size was applied to the calculated effect sizes, resulting in the effect size statistic *d* used for analysis.[36]

For each study, within-group effect sizes were computed separately for each sexual behavior outcome for each group (HIV-positive, HIV-negative, and untested participants; serodiscordant couples; and mixed samples). Effect sizes for serodiscordant couples and mixed samples were calculated separately because these 2 groups differ from the other 3 (i.e., each effect size includes data from both HIV-positive and HIV-negative participants). If a study offered more than 1 follow-up assessment of intervention effectiveness, data from the first follow-up assessment were used. This strategy resulted in a set of 106 effect sizes. When a study yielded more than 1 effect size for the same outcome in the same serostatus group, these effect sizes were averaged, reducing the number of effect sizes

in the data set to 73. Thus, to avoid violating the assumption of independence of effect sizes, each participant was included in only 1 effect size for each outcome.

Analyses followed fixed-effects procedures,[39] which assign greater weight to effect sizes from larger studies on the assumption that larger sample sizes provide more reliable outcomes. The weighted mean effect size, d_+, is an average of the individual studies' effect sizes weighted by the inverse of their variance (i.e., sample size). To determine whether models implied by weighted mean effect sizes describe studies' effect sizes correctly, a homogeneity-of-variance statistic, Q, was computed.[39] Q has an approximate χ^2 distribution with degrees of freedom equal to the number of effect sizes (k) minus 1. A significant Q indicates that the d_+ may not adequately describe the variability in outcomes in a given set of studies. Variability in the magnitude of effect sizes was explained by relating the effect sizes to the studies' characteristics.

Categorical models, based on analysis of variance, and continuous models, based on least squares regression models, were evaluated to test relationships between study characteristics and outcomes. For categorical models, the homogeneity statistic Q_B (between-groups homogeneity) was used to compare d_+ across different groups of studies or participants; a significant test result indicates group differences in d_+. Q_B has an approximate χ^2 distribution with $m-1$ *df*, where m is the number of classes. Within the classes established by the groupings in these models, Q_{Wi} assesses whether the d_+ for each class i describes the effects of the studies within the class correctly. Like Q, Q_{Wi} has an approximate χ^2 distribution with $l-1$ *df*, where l is the number of studies in each class i. Homogeneity was evaluated for all moderator analyses, with a significant homogeneity index, Q_E, indicating that variance remains unexplained. Q_E has an approximate χ^2 distribution with $k-p-1$ *df*, where p is the number of carriers in the model. Separate analyses were conducted for each of the sexual behavior outcomes that were typically reported (i.e., number of partners, condom use, and unprotected intercourse).

Sensitivity analyses were conducted by computing fail-safe n's for group differences found in the primary analyses. The fail-safe n is the number of additional studies averaging no difference that it would take to decrease an observed mean effect size to a particular value. To compute this statistic in the present context, we followed Orwin's formulation,[40]

$$n_{\text{fail-safe}} = k(d_+ - d_c) / d_c,$$

where k is the number of studies in the mean effect size, d_+ is the mean effect size, and d_c is the comparison effect size of interest. In the present context, the comparison for each outcome was the observed mean effect size involving untested participants. The resulting fail-safe n's are relatively conservative estimates of the number of studies required to nullify differences between the 2 mean effect sizes.

Results

Summary of Methodological Features of HIV-CT Studies

Twenty-seven studies,[41–67] representing a total of 19 597 participants, met the inclusion criteria. The number of tested participants in the studies ranged from 14 to 1080; the number of untested participants ranged from 12 to 4524. Sixty-eight percent of the studies reported attrition rates, which ranged from 5% to 89% (mean = 33%). Nineteen (70%) of the studies were conducted in North America, 6 (22%) were conducted in Africa, and 2 (8%) were conducted in Europe. Time elapsed prior to the first follow-up assessment ranged from 16 days to 4 years (median = 180 days).

Five types of research design appeared in the sample: (1) cohort studies that compared behavioral data collected before and after antibody testing was introduced (in 1985) and assessed whether participants had been tested and, if so, the results (8%); (2) cohort studies that compared the behavioral responses of individuals whose blood was sampled for the study and who chose to be told their test results and receive counseling with those of individuals who also had their blood sampled but chose not to receive their results (32%; the latter participants were considered "untested" for the purposes of this review because they did not learn their test results or receive counseling); (3) studies that compared behavioral data collected before and after testing was conducted among people who sought HIV-CT at a testing site, people who were offered and accepted testing, or people in treatment for injection drug use (44%); (4) studies in which participants (who did not originally plan to be tested) were randomly assigned to testing or to 1 or more control groups (12%); and (5) one study that compared prenotification and postnotification data among people who tested HIV-positive when donating blood and received counseling with their test results (4%). Detailed study characteristics appear in Table 1.

The studies generally provided little or no detail about the counseling used. Only 4 studies mentioned the length of counseling sessions, and 7 studies provided no information at all. Although 5 studies supplemented counseling with other components, including peer-group discussion,[55] videotaped presentations,[41,42] and partner counseling,[42,53,61] these reports did not include details of the counseling procedures. Typically, studies did not indicate whether procedures adhered to federal or other HIV-CT guidelines. Because of the inconsistent amount of information reported, moderator analyses using characteristics of counseling could not be conducted.

Outcomes typically assessed were number of sexual partners, condom use, and unprotected intercourse. Information about these variables was obtained via interviews or self-administered questionnaires with different levels of specificity and precision (e.g., reporting periods ranged from 10 days to 2 years). Two studies provided data on HIV or STD incidence.[41,60]

Primary Analyses

The 73 effect sizes used in the primary analyses represent data from 6558 tested and 6685 untested participants. Table 2 displays the effect sizes by behavior, and Figure 1 depicts the results of analyses by behavior and group.

Unprotected intercourse. Twenty-one effect sizes were based on unprotected-intercourse data. As hypothesized, the weighted mean effect sizes for the HIV-positive group (d+ = 0.47; 95% confidence interval [CI] = 0.32, 0.61) and the serodiscordant couple group (d+ = 0.75; 95% CI = 0.59, 0.92) indicated significant risk reduction, and both were greater than the weighted mean effect size for the untested participants (d+ = 0.16; 95% CI = 0.07, 0.25) [QB(1) = 12.67, $P < .001$, and $Q_B(1) = 37.23$, $P < .001$, respectively]. Contrary to prediction, however, the HIV-negative participants ($d_+ = 0.19$; 95% CI = 0.08, 0.31) did not reduce their frequency of unprotected intercourse relative to untested participants [$Q_B(1) = 0.17$, not significant (NS)]. Effect sizes in the untested and HIV-serodiscordant couple groups were homogeneous. Sensitivity analyses for the unprotected-intercourse outcome revealed that it would take 7 studies with null results to reduce the serodiscordant-couple mean effect size to the same value as that for the untested participants, and it would take 10 studies with null results to reduce the mean effect size for the HIV-positive individuals to be statistically equivalent to that of the untested participants.

Condom use. Twenty-two effect sizes were based on condom-use measures. Weighted mean effect sizes for the HIV-positive group ($d_+ = 0.65$; 95% CI = 0.42, 0.87) and the serodiscordant-couple group ($d_+ = 1.31$; 95% CI = 1.14, 1.48) were positive, significant,

TABLE 1—Characteristics of Studies Included in a Meta-Analysis of 27 Studies of HIV Counseling and Testing (HIV-CT)

			Sample Characteristics					
Author (Year)	Location	Design[a]	n	Source	Mean Age, y	% Female	% Hetero-sexual	Days to First Follow-Up
Allen et al. (1992)[41]	Kigali, Rwanda	C	1666	Prenatal and pediatric clinics	29.0	100	NR	90
Allen et al. (1992)[42]	Kigali, Rwanda	C (couples)	57	Prenatal and pediatric clinics	32.5	50	100	90
Calsyn et al. (1992)[43]	Seattle, Wash	D	313	IDU treatment facility	39.1	32	NR	120
Casadonte et al. (1990)[44]	New York, NY	B	81	MMTP	37.0	0	100	70
Cleary et al. (1991)[45]	New York, NY	E	271	Blood donors	27.0	22	45	16
Coates et al. (1987)[46]	San Francisco, Calif	A	502	Community cohort study	NR	0	0	760
Doll et al. (1990)[47]	San Francisco, Calif	B	309	Community cohort study	37.0	0	0	501
Fox et al. (1987)[48]	Baltimore, Md; Washington, DC	B	1001	Community cohort study	36.0	0	0	180
van Griensven et al. (1989)[49]	Amsterdam	A	307	Community cohort study	36.0	0	0	180
Huggins et al. (1991)[50]	Pittsburgh, Pa	B	155	Community cohort study	NR	0	0	180
Ickovics et al. (1994)[51]	New Haven, Conn	C	230	Community health clinics	30.8	100	100	90
Jackson et al. (1997)[52]	Nairobi, Kenya	C	556	Trucking company employees	29.0	0	100	104
Kamenga et al. (1991)[53]	Kinshasa, Zaire	C (couples)	149	Factory HIV screening program	35.5	50	100	50
Landis et al. (1992)[54]	Durham and Wake counties, NC	C	57	County health departments	30.0	30	12	365
Magura et al. (1990)[55]	New York, NY	C	48	MMTP	NR	38	NR	90
McCusker et al. (1996)[56]	Worcester, Mass	C	4267	IDU programs and correctional facilities	NR	32	NR	365
Müller et al. (1992)[57]	Kampala, Uganda	C	200	Public HIV-CT site	25.0	33	NR	180
Nicolosi et al. (1991)[58]	Northern Italy	B	933	Drug treatment centers	25.0	23	NR	312
Ostrow et al. (1989)[59]	Chicago, Ill	B	474	MACS	35.5	0	0	365
Otten et al. (1993)[60]	Miami, Fla	C	5522	STD clinic chart review	25.0	27	NR	180
Padian et al. (1993)[61]	San Francisco, Calif	C (couples)	144	Various HIV-CT sites	34.0	50	100	180
Pickering et al. (1993)[62]	The Gambia	B	31	Prostitutes at Medical Research Council clinics	NR	100	NR	30
Schechter et al. (1988)[63]	Vancouver, BC	B	361	Community cohort study	NR	0	0	730
Wenger et al. (1991)[64]	Los Angeles, Calif	D	370	University health clinic	27.0	33	NR	56
Wenger et al. (1992)[65]	Los Angeles, Calif	D	186	STD clinic	23.0	72	100	180
Wilson et al. (1996)[66]	Brooklyn, NY	C	808	Gynecology and family planning clinics	30.0	100	100	120
Zapka et al. (1991)[67]	Boston, Mass	B	249	Community health center	31.6	0	0	1460

Note. NR = not reported; IDU = injection drug use; MMTP = methadone maintenance treatment program; MACS = Multicenter AIDS Cohort Study; STD = sexually transmitted disease.

[a]Study designs were as follows: A = cohort study comparing behavioral data collected before and after antibody testing was introduced and assessing whether participants had been tested and the result; B = cohort study comparing behavioral responses of participants whose blood was sampled for a study and who chose to receive test results and counseling with those of individuals who also had blood drawn but who chose not to receive test results; C = study comparing behavioral data collected before and after testing was conducted among people who sought testing, people who were offered and accepted testing, or people in treatment for injection drug use; D = study in which participants (who did not originally plan to be tested) were randomly assigned to testing or to a control group; E = study comparing prenotification and postnotification behavioral data among people who tested HIV-positive when donating blood and received counseling with their test results.

and homogeneous, and, as predicted, both were greater than the weighted mean effect size for the untested participants [$Q_B(1) = 16.42$, $P < .001$, and $Q_B(1) = 147.43$, $P < .001$, respectively]. Once again, HIV-negative participants ($d_+ = 0.05$, 95% CI = –0.02, 0.13) did not increase their condom use more than those who were untested ($d_+ = 0.15$, 95% CI = 0.08, 0.17) [$Q_B(1) = 3.10$, NS]. Sensitivity analyses for the condom-use outcome revealed that it would take 23 studies with null results to reduce the serodiscordant-couple mean effect size to the same value as that for the untested participants, and it would take 13 studies with null results to reduce the mean effect size for the HIV-positive individuals to be statistically equivalent to that of the untested participants.

Number of sexual partners. Twenty-five effect sizes were based on number of sexual partners. The weighted mean effect size for the HIV-positive group was significantly positive ($d_+ = 0.34$; 95% CI = 0.20, 0.47). The weighted mean effect size for the HIV-negative group ($d_+ = 0.20$; 95% CI = 0.14, 0.26) was also positive and significant. Contrary to predictions, however, neither the HIV-positive group nor the HIV-negative group exhibited greater change than the untested group ($d_+ = 0.24$; 95% CI = 0.17, 0.30). There was significant heterogeneity of effect sizes in each group. There were no data on numbers of sexual partners from studies of serodiscordant couples.

HIV and STD incidence. Four additional effect sizes based on HIV and STD incidence data were available from 2 studies.[41,60] These data indicated that the incidence of STD infection decreased among HIV-positive participants ($d_+ = 0.15$, 95% CI = 0.04, 0.26) but increased among HIV-negative participants ($d_+ = –0.17$, 95% CI = –0.27, –0.06) and among untested participants ($d_+ = –0.05$, 95% CI = –0.09, –0.01). The weighted mean effect size for HIV-positive participants was significantly greater than those for the HIV-negative and untested participants. The difference between the HIV-negative group and the untested group approached significance [$Q_B(1) = 3.53$, $P = .06$]. In the one study presenting data on changes in HIV incidence from before and after HIV-CT,[41] the effect did not differ from zero ($d_+ = 0.09$, 95% CI = –0.01, 0.17).

To assess whether studies that contributed only one effect size to the analyses affected the results, we also conducted analyses by group and behavior, using only matched samples (i.e., using only studies that contributed both an HIV-positive or HIV-negative and an untested effect size for each out-

TABLE 2—Weighted Mean Effect Size and Related Statistics, by Sexual Risk Behavior and Participants' Serostatus Group, for 27 Studies of HIV Counseling and Testing

Behavior and Group	d_+	Q_B	95% Confidence Interval	k	n	Q_w
Unprotected intercourse						
HIV+	0.47[a]	45.96[b]	(0.32, 0.61)	5	402	19.21[b]
HIV–	0.19		(0.08, 0.31)	7	599	27.94[b]
Discordant couples	0.75[a]		(0.59, 0.92)	2	293[c]	2.20
Untested	0.16		(0.07, 0.25)	5	939	4.41
Condom use						
HIV+	0.65[a]	191.56[b]	(0.42, 0.87)	4	160	4.23
HIV–	0.05		(–0.02, 0.13)	9	1238	13.72
Discordant couples	1.31[a]		(1.14, 1.48)	3	329[c]	24.82[b]
Untested	0.15		(0.08, 0.23)	5	1276	60.74[b]
No. of sexual partners						
HIV+	0.34	3.41[b]	(0.20, 0.47)	5	419	10.03[b]
HIV–	0.20		(0.14, 0.26)	12	2061	66.91[b]
Untested	0.24		(0.17, 0.30)	8	1691	21.04[b]

Note. d_+ = Mean effect size weighted by sample size (the direction of the effect size for each behavior is such that a positive value reflects a decrease in risk for HIV infection); Q_B = between-group homogeneity statistic for mean weighted effect size; k = number of studies contributing an effect size; Q_W = within-group homogeneity statistic.
[a]d_+ is greater than that of the untested group ($P < .05$).
[b]Significant at $P < .05$.
[c]Number of couples.

come). The pattern of results was identical to that from the primary analyses, although because of lower statistical power, some group differences did not remain significant.

Moderator Analyses

For each potential moderator of effect size, analyses were conducted with tested participants across serostatus groups for each outcome, and the effects of serostatus were statistically controlled. The results of these analyses are shown in Table 3. For each analysis, significant heterogeneity remained after application of the moderator.

Seroprevalence. Seroprevalence in the sample was positively associated with risk reduction in terms of unprotected sex (β [standardized β weight] = .86, $P < .005$), but did not moderate condom use (β = .04, NS) or number of sexual partners (β = .02, NS).

Age. The average age of participants was a significant moderator of HIV-CT effect size for condom use. Age was positively associated with risk reduction in terms of condom use (β = .25, $P < .005$), but was not a moderator of unprotected sex (β = .09, NS) or number of sexual partners (β = –.14, NS).

Sex. The proportion of female participants in the samples did not moderate effect sizes for unprotected intercourse (β = .09, NS), condom use (β = –.04, NS), or number of sexual partners (β = .17, NS).

Attrition rate. Attrition rate did not moderate effect sizes for unprotected intercourse (β = –.01, NS), condom use (β = .05, NS), or number of sexual partners (β = –.22, NS).

Length of follow-up. Length of time between receipt of test results and the first follow-up assessment was positively associated with effect size for number of sexual partners (β = .53, $P < .005$). However, length of follow-up was not associated with effect sizes for condom use (β = –.01, NS) or unprotected intercourse (β = –.21, NS).

Volition for testing. The weighted mean effect size for unprotected intercourse among participants who sought testing ($d_+ = 0.52$, 95% CI = 0.38, 0.65) was larger than the corresponding effect size among participants who were offered and accepted testing as part of a study ($d_+ = 0.35$, 95% CI = 0.26, 0.45) [$Q_B(1) = 4.09$, $P < .05$]. There were no differences between these 2 groups in effect sizes for condom use or number of sexual partners.

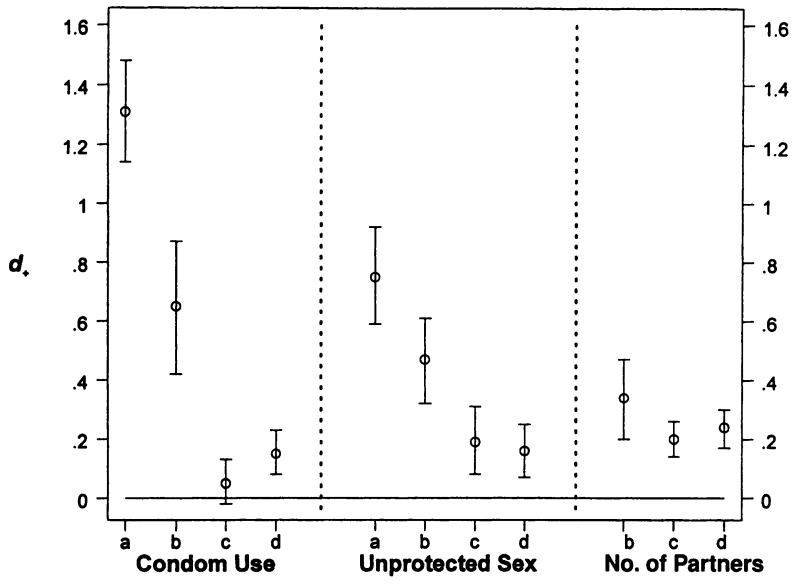
Injection drug use treatment. For condom use, the weighted mean effect size among tested participants who were in treatment for injection drug use ($d_+ = 0.04$, 95% CI = –0.07, 0.15) was not different from zero and homogeneity was nonsignificant [Q_w = 1.99, NS]. The weighted mean effect size for condom use was larger among other participants ($d_+ = 0.44$, 95% CI = 0.35, 0.52) than among participants in treatment for injection drug use [$Q_B(1) = 31.52$, $P < .001$]. Participants who were in treatment for injection drug use did not modify their level of unprotected intercourse ($d_+ = –0.11$, 95% CI = –0.56, 0.33), whereas participants who were not in treatment exhibited a significant reduction in unprotected intercourse ($d_+ = 0.37$, 95% CI = 0.29, 0.45) [$Q_B(1) = 4.44$, $P < .05$].

Random-Effects Analyses

In a parallel set of analyses conducted to test the robustness of our fixed-effects analyses, we also conducted the a priori hypothesis tests and moderator analyses with random-effects assumptions.[68] Compared with fixed-effects procedures, random-effects procedures generally yield more conservative results in terms of significance testing. The pattern of findings remained identical under random-effects assumptions, with one exception: for the unprotected-intercourse outcome, the mean effect size among HIV-positive participants was no longer different from that of untested participants. The random-effects analyses of continuous moderators yielded the same pattern of results as the fixed-effects analyses.

Discussion

Overall, HIV-positive participants and HIV-serodiscordant couples in the 27 studies examined reduced their frequency of unprotected intercourse and increased their condom use, relative to HIV-negative and untested participants, after receiving HIV counseling and testing. Furthermore, in 2 studies, HIV-positive participants exhibited reduced STD incidence relative to HIV-negative and untested participants. These findings indicate that HIV-CT is an effective *secondary* HIV prevention strategy; that is, participants who learned that they were HIV-positive did reduce their sexual risk behavior, thereby



Note. a = HIV-serodiscordant couples; b = HIV-positive participants; c = HIV-negative participants; d = untested participants.

FIGURE 1—Weighted mean effect size (with 95% confidence interval) for HIV counseling and testing from 27 published studies, by type of risk behavior and participants' HIV serostatus group.

decreasing their risk of subsequent reinfection and their risk of infecting others. Participants who received a negative HIV test result, however, did not modify their sexual risk behavior any more than individuals who did not participate in counseling and testing. Therefore, HIV-CT does not appear to be an effective *primary* prevention strategy.

The finding that HIV-positive participants reduced their frequency of unprotected intercourse, relative to untested participants, was not supported by subsequent random-effects analysis. This discrepancy may indicate that the significant finding, observed under fixed-effects assumptions, is not robust. However, the significant reduction in STD incidence is additional evidence that HIV-positive participants did reduce their frequency of unprotected intercourse in addition to increasing their use of condoms. The results of all other random-effects analyses were equivalent to those obtained with fixed-effects procedures.

Moderator analyses revealed several factors associated with the variation in study results, beyond the effects of serostatus group, for each of the major sexual behavior outcomes. In response to HIV-CT, samples with higher seroprevalence tended to decrease their frequency of unprotected intercourse more than did samples with lower seroprevalence. St. Lawrence et al.[69] showed that men living in a city with a high prevalence of HIV infection were more likely than men living in a low-prevalence city to be exposed to HIV prevention messages, to know of others infected with HIV, and to possess accurate information about HIV and AIDS. This increased awareness may result in heightened perceptions of risk and intentions to change behavior, which combine with HIV-CT to result in risk reduction.

Three participant characteristics moderated the effectiveness of HIV-CT. First, older samples increased their condom use more than did younger samples. This finding may reflect a general trend toward more risk reduction among older persons, perhaps because of maturity or stability of relationships, or because actual or perceived control of condom use increases with age.

Second, participants who autonomously sought HIV-CT reduced their frequency of unprotected intercourse more than those who were offered HIV-CT as part of a research program. Participants who sought testing may have used testing as part of a risk reduction plan[67,70] or may have been more actively contemplating behavior change. This finding also indicates that to gain a better understanding of the effectiveness of HIV-CT, future studies should be conducted at testing sites with individuals who are seeking testing; research with participants who are not seeking testing may not accurately represent the effects of HIV-CT as it is implemented. Similarly, studies in which the participants came from injection drug use treatment programs did not find significant behavior changes with regard to condom use or unprotected intercourse, compared with studies using participants from other sources. This result was anticipated, because the emphasis of HIV-CT for participants in injection drug use treatment is often on needle-sharing rather than sexual behavior. Because sexual contact with individuals infected with HIV through injection drug use is a significant source of HIV infection,[1] efforts are needed to improve the sexual risk reduction effects of HIV-CT in this group.

Finally, studies that had longer follow-up periods had larger effect sizes for number of sexual partners. This finding may reflect the fact that number of sexual partners is an outcome that is not sensitive to change during shorter intervals.

A caveat about the results of the moderator analyses is warranted. The heterogeneity of effect sizes within serostatus groups and the remaining unexplained variance in the analysis of continuous moderators suggest that other moderators would more completely explain the variation in study outcomes. We discuss some of these potential moderators below.

Critique of the Literature

Two limitations of the reviewed studies merit discussion. First, the heterogeneity of effect sizes and the number of significant moderators suggest that participants' responses to HIV-CT are multiply determined and complex. However, with only a few exceptions, HIV-CT studies have not been informed by theories of behavior change, and investigators have paid little attention to the psychological factors that may interact with testing to affect behavior. This atheoretical approach contrasts with other contemporary HIV prevention interventions,[71] in which researchers typically examine the effects of an intervention on theoretical determinants of risk behavior (e.g., HIV-related skills, perceived social norms, and intentions for behavior change). Assessing the hypothesized determinants of behavior can help to identify mechanisms of change, is central to the iterative process of theory-driven research, and can guide the development and refinement of interventions.

For example, a theoretical framework that is often applied to the design and evaluation of HIV risk reduction interventions is the Information–Motivation–Behavioral Skills model of AIDS preventive behavior.[72] According to this model, the effects of HIV-related information and risk reduction motivation on sexual behavior are mediated by the use of specific

TABLE 3—Associations between Continuous Study Characteristics and Sexual Behavior Effect Sizes in 27 Studies of HIV Counseling and Testing

Moderator and Study Outcome	*k*	β[a]	Q_E[b]
Seroprevalence of participants			
Unprotected sex	15	.86*	60.09
Condom use	17	.04	43.85
No. of sexual partners	17	.02	78.21
Age of participants			
Unprotected sex	14	.09	54.86
Condom use	12	.25*	30.82
No. of sexual partners	12	−.14	72.68
Sex of participants			
Unprotected sex	16	−.14	68.55
Condom use	17	−.04	43.56
No. of sexual partners	17	.17	75.91
Attrition rate			
Unprotected sex	11	−.01	28.03
Condom use	13	.05	36.71
No. of sexual partners	12	−.22	58.05
Length of follow-up			
Unprotected sex	16	−.21	66.68
Condom use	17	−.01	43.94
No. of sexual partners	17	.53*	56.11

Note. *k* = number of effect sizes included in analysis; β = standardized regression weight; Q_E = homogeneity statistic.
[a]Analyses were controlled for HIV-serostatus group.
[b]All significant at $P < .01$.
*$P < .005$.

behavioral skills, such as condom negotiation with a sexual partner and the ability to apply a condom correctly. Without such behavioral skills, a well-informed and motivated individual may find it difficult to modify his or her sexual risk behavior. Other theoretically relevant factors that may predict behavioral change in HIV-CT are participants' estimation of their odds of being infected with HIV[73] and participants' appraisal of and method of coping with the potential threat of learning that they are HIV-seropositive.[74] Assessing these constructs before and after HIV-CT would permit stronger inferences about the effects of the intervention on these moderators; HIV-CT procedures could then be modified to produce a greater impact on behavior.

In this meta-analysis, volition for testing and injection drug use treatment status were the only moderators that could be construed as proxies for psychological factors, but both are sample characteristics that remained consistent throughout the course of the studies. None of the moderating variables that could be tested represented modifiable constructs, such as information, motivation, or behavioral skills. If we are to understand and enhance HIV-CT's effectiveness in reducing risk behavior, we must be guided by theories of behavior change and we must measure key constructs.

A second limitation of the HIV-CT literature involves the absence of details about counseling. Although the CDC provides technical guidance for HIV test counseling,[11] many counselors may disregard these guidelines,[75] believing that risk reduction counseling is ineffective.[76] If variations in counseling technique are not documented, our ability to evaluate the effects of HIV-CT is limited. Failure to specifically define the independent variable threatens the validity of any study[77] and in this case makes it difficult to determine what components of HIV-CT are responsible for behavior change. In the absence of details about the counseling, what the current meta-analysis provides is an evaluation of the effects on risk behavior of the *experience* of counseling and testing. However, an important question remains unanswered: Do different amounts and qualities of pretest and posttest counseling result in differences in risk reduction? A study of a large randomized controlled trial of HIV-CT among heterosexual HIV-negative participants in urban STD clinics, published while this article was in press, begins to answer this question. The CDC's Project RESPECT found that, compared with standard HIV-CT procedures, enhanced counseling consisting of either 2 or 4 interactive sessions resulted in increased condom use and decreased STD infections.[78]

Conclusions

Five conclusions can be drawn from this meta-analysis of the HIV-CT literature:

1. *HIV-CT appears to provide an effective means of secondary prevention for HIV-positive individuals.* HIV-positive individuals who underwent HIV-CT increased their safer-sex behaviors and reduced their risk behaviors, thereby decreasing their likelihood of infecting others or becoming reinfected with HIV or other STDs. The significant variability in study outcomes suggests that there is much more to learn about the conditions under which HIV-CT is effective in reducing risk behavior and sustaining risk behavior change among HIV-positive participants.

2. *HIV-CT, at least as it was implemented in the studies reviewed, does not appear to be an effective intervention for the primary prevention of HIV infection.* HIV-negative individuals did not reduce their risk behavior, relative to untested participants, after HIV-CT. However, because inadequate attention has been paid to the psychological and social contexts of testing, the theoretical grounding of counseling, and the type and amount of counseling provided, a closer examination of these factors may reveal that HIV-CT is effective with HIV-negative individuals under some circumstances.

3. *Theory-driven research is needed to further explicate the determinants of behavior change in HIV-CT.* Programmatic research is needed to isolate the psychological determinants of behavior change associated with HIV-CT and to develop and evaluate theory-guided interventions. An appropriate conceptual framework for HIV-CT needs to take into account the context of testing. For example, HIV-CT may be obtained by couples at the beginning of a monogamous sexual relationship. Such individuals would not be expected to increase their condom use and may in fact increase their frequency of unprotected intercourse. Studies that attempt to evaluate the effectiveness of HIV-CT would benefit from obtaining and reporting more specific information about participants' relationship status, reasons for seeking testing, and testing history.

4. *Research is needed to examine the effectiveness of specific counseling approaches.* Research should examine the effects of theory-based counseling with different contents, modes of delivery, and levels of intensity. For example, the amount of counseling provided with standard HIV-CT (i.e., 5 to 10 minutes of pretest counseling and 10 to 30 minutes of posttest counseling) may not be sufficient to increase motivation for behavior change in most individuals. In contrast to other HIV-related behavioral interventions, the amount of counseling typically provided in HIV-CT is inadequate to foster a reduction in risk behavior.[71] Future research might also address the role of counseling in

the context of new home testing and rapid testing technologies.[79–82]

5. *HIV-CT should be viewed as one part of an overall HIV prevention strategy that also includes individual-, community-, and policy-level interventions.* Despite the widespread use of HIV-CT, it should not be regarded as the sole strategy for HIV prevention. Rather, HIV-CT should be viewed as one part of a comprehensive set of strategies, drawing on programs that have been shown to be effective for primary prevention.[83] These strategies should target not only the individual, as in interpersonal skills training programs,[84] but also communities[85] and social policies.[86] It is only through integrated efforts at these multiple levels that the HIV epidemic will be addressed adequately. □

Contributors

L. S. Weinhardt and M. P. Carey conceptualized the study and developed the initial proposal for the project. L. S. Weinhardt completed the literature search, developed the coding protocol, and assembled the research materials for coding. L. S. Weinhardt and N. L. Bickham coded study characteristics. L. S. Weinhardt and B. T. Johnson calculated the effect sizes and conducted the analyses. All authors interpreted the results. L. S. Weinhardt and M. P. Carey prepared the initial draft of the manuscript. All authors revised the initial draft and approved the final version of the paper.

Acknowledgments

This study was supported by grants from the National Institute of Mental Health (K21-MH0110, K21-MH01377, and F31-MH11125).

References

1. Centers for Disease Control and Prevention. *HIV/AIDS Surveillance Report.* 1998;10(1).
2. Rosenberg PS. Scope of the AIDS epidemic in the United States. *Science.* 1995;270:1372–1375.
3. DeCock KM, Barrere B, Diaby L. AIDS: the leading cause of adult death in the West African city of Abidjan, Ivory Coast. *Science.* 1990; 249:793–796.
4. Mulder DW, Nunn AJ, Kamali A, Nakiyingi J, Wagner HU, Kengeya-Kayondo JF. Two-year HIV-1 associated mortality in a Ugandan rural population. *Lancet.* 1994;343:1021–1023.
5. Bartlett JG. Protease inhibitors for HIV infection. *Ann Intern Med.* 1996;124:1086–1088.
6. Centers for Disease Control and Prevention. Clinical update: impact of HIV protease inhibitors on treatment of HIV-infected tuberculosis patients with rifampin. *MMWR Morb Mortal Wkly Rep.* 1996;45:921–925.
7. Holmberg SD, Curran JW. The epidemiology of HIV infection in industrialized countries. In: Holmes KK, Mardh PA, Sparling PF, et al., eds. *Sexually Transmitted Diseases.* 2nd ed. New York, NY: McGraw-Hill; 1990:343–353.
8. Mann J, Tarantola D. *AIDS in the World II: Global Dimensions, Social Roots, and Responses.* New York, NY: Oxford University Press; 1996.
9. Campbell CH Jr, Marum ME, Alwano-Edyegu M, Dillon BA, Moore M, Gumisiriza E. The role of HIV counseling and testing in the developing world. *AIDS Educ Prev.* 1997;9(Suppl B): 92–104.
10. Centers for Disease Control and Prevention. Technical guidance on HIV counseling. *MMWR Morb Mortal Wkly Rep.* 1993;42(RR-2):11–16.
11. Anderson JE. CDC data systems collecting behavioral data on HIV counseling and testing. *Public Health Rep.* 1996;11:129–132.
12. Shoenborn CA, Marsh SL, Hardy AM. *AIDS Knowledge and Attitudes for 1992: Data From the National Health Interview Survey.* Hyattsville, Md: National Center for Health Statistics; 1994.
13. *HIV Counseling and Testing in Publicly Funded Sites: 1993–1994 Summary Report.* Atlanta, Ga: Centers for Disease Control and Prevention; 1996.
14. Weber JT, Frey RL Jr, Horsley R, Gwinn ML. Publicly funded HIV counseling and testing in the United States, 1992–1995. *AIDS Educ Prev.* 1997;9(Suppl B):79–91.
15. Holtgrave DR, Valdiserri RO, Gerber R, Hinman AR. Human immunodeficiency virus counseling, testing, referral, and partner notification services: a cost-benefit analysis. *Arch Intern Med.* 1993;153:1225–1230.
16. Doll LS, Kennedy MB. HIV counseling and testing: what is it and how well does it work? In: Schochetman G, George JR, eds. *AIDS Testing: A Comprehensive Guide to Technical, Medical, Social, Legal, and Management Issues.* 2nd ed. New York, NY: Springer-Verlag; 1994: 302–319.
17. Cates W Jr, Handsfield HH. HIV counseling and testing: does it work? *Am J Public Health.* 1988;78:1533–1534.
18. Coates TJ, Stall RD, Kegeles SM, Lo B, Morin SF, McKusick L. AIDS antibody testing: will it stop the AIDS epidemic? will it help people infected with HIV? *Am Psychol.* 1988;43: 859–864.
19. Higgins DL, Galavotti C, O'Reilly KR, et al. Evidence for the effects of HIV antibody counseling and testing on risk behaviors. *JAMA.* 1991;266:2419–2429.
20. Rugg DL, MacGowan RJ, Stark KA, Swanson NM. Evaluating the CDC program for HIV counseling and testing. *Public Health Rep.* 1991;106:708–713.
21. Phillips KA, Coates TJ. HIV counseling and testing: research and policy issues. *AIDS Care.* 1995;7:115–124.
22. Wolitski RJ, MacGowan RJ, Higgins DL, Jorgensen CM. The effects of HIV counseling and testing on risk-related practices and help-seeking behavior. *AIDS Educ Prev.* 1997;9(Suppl B): 52–67.
23. Hunt M. *How Science Takes Stock: The Story of Meta-Analysis.* New York, NY: Russell Sage; 1997.
24. Rosenthal R. *Meta-Analytic Procedures for Social Research.* Newbury Park, Calif: Sage Publishing; 1991.
25. Colón HM, Robles RR, Marrero CA, Reyes JC, Sahai H. Behavioral effects of receiving HIV test results among injecting drug users in Puerto Rico. *AIDS.* 1996;10:1163–1168.
26. Magura S, Siddiqi Q, Shapiro J, et al. Outcomes of an AIDS prevention program for methadone patients. *Int J Addict.* 1991;26:629–655.
27. Adib SM, Joseph JG, Ostrow DG, Tal M, Schwartz SA. Relapse in sexual behavior among homosexual men: a 2-year follow-up from the Chicago MACS/CCS. *AIDS.* 1991;5: 757–760.
28. van Griensven GJ, de Vroome EM, Tielman RA, et al. Impact of HIV antibody testing on changes in sexual behavior among homosexual men in the Netherlands. *Am J Public Health.* 1988;78:1575–1577.
29. Kuiken CL, van Griensven GJ, de Vroome EM, Coutinho RA. Risk factors and changes in sexual behavior in male homosexuals who seroconverted for human immunodeficiency virus antibodies. *Am J Epidemiol.* 1990;132:523–530.
30. McCusker J, Stoddard AM, Mayer KH, Zapka J, Morrison C, Saltzman SP. Effects of HIV antibody test knowledge on subsequent sexual behaviors in a cohort of homosexually active men [published correction appears in *Am J Public Health.* 1988;78:1530]. *Am J Public Health.* 1988;78:462–467.
31. McKusick L, Coates TJ, Morin SF, Pollack L, Hoff C. Longitudinal predictors of reductions in unprotected anal intercourse among gay men in San Francisco: the AIDS Behavioral Research Project. *Am J Public Health.* 1990;80:978–983.
32. Morrill AC, Ickovics JR, Golubchikov VV, Beren SE, Rodin J. Safer sex: social and psychological predictors of behavioral maintenance and change among heterosexual women. *J Consult Clin Psychol.* 1996;64:819–828.
33. Cohen J. Coefficient of agreement for nominal scales. *Educ Psychol Meas.* 1960;20:37–46.
34. Johnson BT. *DSTAT 1.10: Software for the Meta-Analytic Review of Research Literatures: Upgrade Documentation.* Hillsdale, NJ: Lawrence Erlbaum; 1993.
35. Cohen J. *Statistical Power Analysis for the Behavioral Sciences.* 2nd ed. New York, NY: Academic Press; 1977.
36. Hedges LV. Distribution theory for Glass's estimator of effect size and related estimators. *J Educ Stat.* 1981;6:107–128.
37. Johnson BT, Eagly AH. Quantitative synthesis of social psychological research. In: Reis HT, Judd CM, eds. *Handbook of Research Methods in Social Psychology.* London, England: Cambridge University Press. In press.
38. Snedecor GW, Cochran WG. *Statistical Methods.* 7th ed. Ames: Iowa State University Press; 1980.
39. Hedges LV, Olkin I. *Statistical Methods for Meta-Analysis.* Orlando, Fla: Academic Press; 1985.
40. Orwin RG. A fail-safe N for effect size in meta-analysis. *J Educ Stat.* 1983;8:157–159.
41. Allen S, Serufilira A, Bogaerts J, et al. Confidential HIV testing and condom promotion in Africa: impact on HIV and gonorrhea rates. *JAMA.* 1992;268:3338–3343.
42. Allen S, Tice J, Van de Perre P, et al. Effect of serotesting with counselling on condom use and seroconversion among HIV discordant couples in Africa. *BMJ.* 1992;304:1605–1609.
43. Calsyn DA, Saxon AJ, Freeman G Jr, Whittaker S. Ineffectiveness of AIDS education and HIV antibody testing in reducing high-risk behaviors among injection drug users. *Am J Public Health.* 1992;82;573–575.
44. Casadonte PP, DesJarlais DC, Friedman SR, Rotrosen JP. Psychological and behavioral impact among intravenous drug users of learning HIV test results. *Int J Addict.* 1990;25: 409–426.

45. Cleary PD, Van Devanter N, Rogers TF, et al. Behavior changes after notification of HIV infection. *Am J Public Health.* 1991;81:1586–1590.
46. Coates TJ, Morin SF, McCusick L. Behavioral consequences of AIDS antibody testing among gay men. *JAMA.* 1987;258:1889.
47. Doll L, O'Malley PM, Pershing AL, Darrow WW, Hessol NA, Lifson AR. High-risk sexual behavior and knowledge of HIV antibody status in the San Francisco city clinic cohort. *Health Psychol.* 1990;9:253–265.
48. Fox R, Odaka NJ, Brookmeyer R, Polk BF. Effect of HIV antibody disclosure on subsequent sexual activity in homosexual men. *AIDS.* 1987;1:241–246.
49. van Griensven GJ, de Vroome EM, Tielman RA, et al. Effect of human immunodeficiency virus (HIV) antibody knowledge on high-risk sexual behavior with steady and nonsteady sexual partners among homosexual men. *Am J Epidemiol.* 1989;129:596–603.
50. Huggins J, Elman N, Baker C, Forrester RG, Lyter D. Affective and behavioral responses of gay and bisexual men to HIV antibody testing. *Soc Work.* 1991;36:61–66.
51. Ickovics JR, Morrill AC, Beren SE, Walsh U, Rodin J. Limited effects of HIV counseling and testing for women. *JAMA.* 1994;272:443–448.
52. Jackson DJ, Rakwar JP, Richardson BA, et al. Decreased incidence of sexually transmitted diseases among trucking company workers in Kenya: results of a behavioural risk-reduction programme. *AIDS.* 1997;11:903–909.
53. Kamenga M, Ryder RW, Jingu M, et al. Evidence of marked sexual behavior change associated with low HIV-1 seroconversion in 149 married couples with discordant HIV-1 serostatus: experience at an HIV counselling center in Zaire. *AIDS.* 1991;5:61–67.
54. Landis SE, Earp JL, Koch GG. Impact of HIV testing and counseling on subsequent sexual behavior. *AIDS Educ Prev.* 1992;4:61–70.
55. Magura S, Shapiro JL, Grossman JI, et al. Reactions of methadone patients to HIV antibody testing. *Adv Alcohol Subst Abuse.* 1990; 8:97–111.
56. McCusker J, Willis G, McDonald M, Serett SM, Lewis BF, Sullivan JL. Community-wide HIV counseling and testing in central Massachusetts: who is retested and does their behavior change? *J Community Health.* 1996;21:11–23.
57. Müller O, Barugahare L, Schwartländer B, et al. HIV prevalence, attitudes and behavior in clients of a confidential HIV testing and counselling centre in Uganda. *AIDS.* 1992;6:869–874.
58. Nicolosi A, Molinari S, Musicco M, Saracco A, Ziliani N, Lazzarin A. Positive modification of injecting behavior among intravenous heroin users from Milan and Northern Italy 1987–1989. *Br J Addict.* 1991;86:91–102.
59. Ostrow DG, Joseph JG, Kessler R, et al. Disclosure of HIV antibody status: behavioral and mental health correlates. *AIDS Educ Prev.* 1989;1:1–11.
60. Otten MW, Zaidi AA, Wroten JE, Witte JJ, Peterman TA. Changes in sexually transmitted disease rates after HIV testing and posttest counseling, Miami, 1988 to 1989. *Am J Public Health.* 1993;83:529–533.
61. Padian NS, O'Brien TR, Chang Y, Glass S, Francis DP. Prevention of heterosexual transmission of human immunodeficiency virus through couple counseling. *J Acquir Immune Defic Syndr.* 1993;6:1043–1048.
62. Pickering H, Quigley M, Pepin J, Todd J, Wilkins A. The effects of post-test counseling on condom use among prostitutes in The Gambia. *AIDS.* 1993;7:271–273.
63. Schechter MT, Craib KJP, Willoughby B, et al. Patterns of sexual behavior and condom use in a cohort of homosexual men. *Am J Public Health.* 1988;78:1535–1538.
64. Wenger NS, Greenberg JM, Hilborne LH, Jusseling F, Mangotich M, Shapiro M. Effect of HIV antibody testing and AIDS education on communication about HIV risk and sexual behavior: A randomized, controlled trial in college students. *Ann Intern Med.* 1992;117: 905–911.
65. Wenger NS, Linn LS, Epstein M, Shapiro MF. Reduction of high-risk sexual behavior among heterosexuals undergoing HIV antibody testing: a randomized clinical trial. *Am J Public Health.* 1991;81:1580–1585.
66. Wilson TE, Jaccard J, Levinson RA, Minkoff H, Endias R. Testing for HIV and other sexually transmitted diseases: implications for risk behavior in women. *Health Psychol.* 1996;15: 252–260.
67. Zapka JG, Stoddard A, Zorn M, McCusker J, Mayer KH. HIV antibody test result knowledge, risk perceptions and behavior among homosexually active men. *Patient Educ Couns.* 1991;18:9–17.
68. Raudenbush SW. Random effects models. In: Cooper H, Hedges LV, eds. *The Handbook of Research Synthesis.* New York, NY: Russell Sage; 1994:301–321.
69. St. Lawrence JS, Hood HV, Brasfield T, Kelly JA. Differences in gay men's AIDS risk knowledge and behavior patterns in high and low AIDS prevalence cities. *Public Health Rep.* 1989;104:391–395.
70. Lupton D, McCarthy S, Chapman S. Doing the right thing: symbolic meanings and experiences of having an HIV antibody test. *Soc Sci Med.* 1995;41:173–180.
71. Kalichman SC, Carey MP, Johnson BT. Prevention of sexually transmitted HIV infection: a meta-analytic review of the behavioral outcome literature. *Ann Behav Med.* 1996;18:6–15.
72. Fisher JD, Fisher WA. Changing AIDS risk behavior. *Psychol Bull.* 1992;111:455–474.
73. Kahneman D, Tversky A. On the psychology of prediction. *Psychol Rev.* 1973;80:237–251.
74. Lazarus RS, Folkman S. *Stress, Appraisal, and Coping.* New York, NY: Springer; 1984.
75. Beardsell S, Coyle A. A review of research on the nature and quality of HIV testing services: a proposal for process-based studies. *Soc Sci Med.* 1996;42:733–743.
76. Beardsell S. Should wider HIV testing be encouraged on the grounds of HIV prevention? *AIDS Care.* 1994;6:5–19.
77. Cook TD, Campbell DT. *Quasi-Experimentation: Design and Analysis Issues for Field Settings.* Boston, Mass: Houghton Mifflin; 1979.
78. Kamb ML, Fishbein M, Douglas JM, et al. Efficacy of risk reduction counseling to prevent human immunodeficiency virus and sexually transmitted diseases: a randomized controlled trial. *JAMA.* 1998;280:1161–1167.
79. Branson BM. Home sample collection tests for HIV infection. *JAMA.* 1998;280:1699–1701.
80. Gallo D, George JR, Fitchen JH, Goldstein AS, Hindahl MS. Evaluation of a system using oral mucosal transudate for HIV-1 antibody screening and confirmatory testing. *JAMA.* 1997;277: 254–258.
81. Kassler WJ. Advances in HIV testing technology and their potential impact on prevention. *AIDS Educ Prev.* 1997;9(Suppl B):27–40.
82. Mashu A, Mbizvo MT, Makura E, et al. Evaluation of rapid on-site clinic HIV test, combined with counselling. *AIDS.* 1997;11:932–933.
83. Interventions to prevent HIV risk behaviors. NIH consensus statement. 1997;15(2):1–41. Available at: http://odp.od.nih.gov/consensus/cons/104/104_intro.htm. Accessed May 1999.
84. Carey MP, Maisto SA, Kalichman SC, Forsyth AD, Wright EM, Johnson BT. Enhancing motivation to reduce the risk of HIV infection for economically disadvantaged urban women. *J Consult Clin Psychol.* 1997;65:531–541.
85. Kelly JA, St. Lawrence JS, Stevenson LY, et al. Community AIDS/HIV risk reduction: the results of endorsements by popular people in three cities. *Am J Public Health.* 1992;82: 1483–1489.
86. Watters JK, Estilo MJ, Clark GL, Lovrick J. Syringe and needle exchange as HIV/AIDS prevention for injection drug users. *JAMA.* 1994;217:115–120.